ROTATION SUPPORT OF HEAT-DISSIPATION FAN

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ABSTRACT

An improved structure [of] for rotational support [of] for a heat-dissipation fan is disclosed, comprising a hollow ceramic {hollow] bearing passing [thru] through and [fixed on] concentric with the fan rotor and rotating with said rotor [ceramic], a hollow ceramic support bearing fixedly mounted to the base of the fan, and a hollow or solid ceramic axle tube passing through the inside of said bearing and rotating freely [or fixed to fan body]; to [provide low] reduce friction and allow high-speed rotation. The exterior surface of said bearing is ground or otherwise formed [or grinded] to provide better connection with the rotor, while the interior of the bearing and exterior of the axle tube are further processed to reduce contact area [thereof] therebetween to [lower] reduce rotation friction. This improved structure has achieved [lower] reduced friction, [lower] reduced noise, [lower] reduced power consumption, longer life and higher rotation speed.

BACKGROUND OF THE INVENTION

The present invention relates to an improved structure [of] for rotational support of a heat-dissipation fan, wherein a ceramic bearing is fixed onto a rotor and rotates with it [rotor]. Various ceramic axle tube supporting structures are provided, and interior and exterior surfaces of the bearing and axle tube are further processed to [lower] reduce rotational friction between them [thereof, achieve lower] reduce noise, [lower] reduce power consumption, and achieve longer life and allow higher rotational speed.

Fig. 1 is an exploded view of [prior art] a heat-dissipation fan according to the prior art. [The] Axial shaft 101 is [fixed on] fixedly attached to rotor 100 at one end and surrounded by axle tube 102, [with] supported by either ball bearing 103 or metal sleeve 104 [supports]. When stator coil 105 is energized to generate impelling magnetic force, the circular permanent magnet installed inside rotor 100 [will] acts upon [the] this magnetic force and rotates the motor. The ball bearing 103 or metal sleeve 104 is a key component [to] of fan rotation in the prior art. Ball bearing 103 has a lower coefficient of friction and longer life than metal sleeve 104, but when dust or debris [goes into] enters ball bearing 103, [the] resulting bearing friction rapidly causes it to deteriorate; generating vibration, abnormal heat and loud noise [and]. Eventually the fan will become unstable. In addition, the price of a ball bearing is [among the highest compared with] higher than that of [other solutions] alternative bearing structures. [The] Metal sleeve 104 is

cheap, but wears out very quickly [which], requiring regular maintenance [check] and replacement. In the conventional art, when lubricant [in the prior art] is consumed, abnormal heat and friction will greatly shorten the life of [prior art] the fan.

[In addition,] It should be noted that axial shaft 101 is fixed on rotor 100 and rotates with [rotor] it, while metal sleeve 104 is fixed on the fan base and does not rotate. The friction caused by [whole] surface contact between [them and] axial shaft 101 and sleeve 104, combined with viscosity of lubricant [will] offsets the impelling force created by magnetic forces in stator 105. This results in [resulting] high heat, high friction, [lower] reduced rotor speed and wasting of energy.

The present invention is distinct from the prior art. In the present invention, the ceramic bearings used are self-lubricating, as opposed to lubrication by LASER gas (Derrickson, U.S.Pat. No. 4,975,925 (1990) or air (Ghosh, U.S.Pat. No. 5,738,446 (1998)). The present invention uses only ceramic material, as opposed to Schicktanz, U.S.Pat. No. 5,380,112 (1995), which teaches the use of members made of different materials concentrically aligned. Webb, U.S.Pat. No. 6,208,675 (2001) discloses a complex blower and fan mechanism for a LASER, but it uses ball bearings. The present invention uses ceramic bearings, which constitute and improvement. Recent inventions using ceramic bearings all teach a pin or axial tube that is fixedly attached to either the fan rotor or fan base. Examples are Hsieh, U.S. Pat. No. 5,947,704 (1999)(fixed to base); Tsuchiya, U.S. Pat. No. 6,447,272 (2002)(attached to rotor; no claim as to bearing material) and Lee, U.S.Pat. No. 6,254,348 (2001)(center pin also fixed). In the present invention, the axial tube (pin) is received by both the bearing mounted to the rotor and the bearing mounted to the fan base. This arrangement allows the axial tube to rotate when the fan rotor turns, but not at as high a speed. As shall be shown, this is a novel feature of the present invention.

SUMMARY OF THE INVENTION

[Accordingly,] The object of the present invention is to provide an improved structure [of] for rotational support [of] in a heat-dissipation fan to achieve lower rotational friction. This reduced friction brings the benefits of lower noise, lower power consumption, longer life and higher allowable rotation speed.

In order to achieve [above] these objectives, the present invention provides an improved structure comprising [ceramic] a hollow ceramic bearing passing [thru] through and [fixed on] affixed to the rotor and rotating with it [rotor ceramic], a hollow or solid ceramic tube passing through the inside of the bearing and rotating freely [or fixed to fan body] to [provide low] reduce friction and allow for high speed rotation. The exterior surface of the bearing and the exterior of the axle tube are [further] processed to reduce surface contact area [thereof lower] between them, thereby further reducing rotational friction.

The [first preferred embodiment of the] present invention comprises a ceramic hollow [tube shape] tubular bearing, support bearing and axle tube, and a ceramic holding ring. The bearing passes through and [fixes on] is fixedly attached to the fan rotor and rotates with the

rotor, [while] the support bearing [fixes on] is fixedly attached to the fan base, [and work] acting as structural support, [which do] and does not rotate. The axle tube is either cylindrical in shape or contains an end flange portion, forming a T-shaped (in cross-section) tube [and]. The axle tube passes through the inside of the bearing and support bearing, and rotates asynchronously and freely with the fan rotor. The axle tube functions as structural support, providing multi-point contact with the rotating support mechanism. The ceramic holding ring has an opening or gap and is installed at one end of the axle tube to [limit axial movement of the axle tube.

When the heat-dissipation fan is energized and [in rotation] rotating, the bearing [is rotating] rotates with the rotor [and]. The axle tube [will be] is then carried forward asynchronously and incrementally, thereby [and] rotating slowly within the bearing. Since the bearing and axle tube are rotating at different speeds in the same direction, [it will greatly reduce] friction is reduced and [increase] fan speed and efficiency are increased. To avoid [axial direction] movement of the axle tube in the axial direction, a ceramic holding ring (a C-ring) is installed at the end of the axle tube furthest from the fan rotor. The rotating bearing, fixed support bearing, free-moving axle tube and auto balancing of magnetic force [will] combine to create a very stable high speed [multi-point contact] rotating support mechanism with multipoint contact, delivering minimum vibration and friction.

The bearing and support bearing are [ceramic] hollow ceramic tubes, the exteriors of which [bearing and support bearing] are [formed or] ground [to] or otherwise formed with a concave surface [with smaller outer diameter or non-circular shape] or [concave] a grooved shape, to provide a simple but solid connection with the fan rotor body, [and is] suitable for mass production of [embedded] injection molded [of] fan rotor bodies. The interior of the bearing and support bearing are [formed or] ground or otherwise formed with concave grooves to further reduce surface contact [surface] and friction among bearing, support bearing and axle tube.

The axle tube is a solid or hollow ceramic tube with a cylindrical shape, or with an end flange portion forming a T-shape (in cross-section). The exterior of the axle tube is [formed or] ground or otherwise formed with concave grooves or with a non-circular shape to further reduce surface contact [surface] and friction among bearing, support bearing and axle tube.

In addition, the gap between bearing/support bearing and axle tube is kept below ten microns to [avoid rotation] prevent vibration and noise.
In width

THE REMAINING MATERIAL IN THIS SECTION, WHICH DESCRIBED SECOND AND THIRD EMBODIMENTS OF THE INVENTION, IS NOW OMITTED ENTIRELY.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 [is] shows an exploded view of [prior art] a heat-dissipation fan, according to the prior art.

Fig. 2 [is] shows an exploded view of the present invention.

Figs. 3Aa through 3Ad show [the] cross-sectional views of various axle tubes used in the practice of the present invention.

Fig. 3B shows [the] a bottom view of the axle tube used in the present invention.

Fig. 3C shows [the] a top view of the axle tube used in the present invention.

Figs. 4Aa and 4Ab show cross-sectional views of the bearing and support bearing, respectively.

Figs. 4Ba and 4Bb show top views of the bearing and support bearing, respectively.

Fig. 4C shows a cross-sectional view of an embedded ceramic bearing in an injection molded [of] fan rotor.

Fig. 5 shows a cross-sectional view of [the first preferred embodiment of] the present invention.

[Fig. 6 shows cross sectional view of the second preferred embodiment of the present invention.]

[Fig. 7 shows cross sectional view of the third preferred embodiment of the present invention.]

[Fig. 8 shows front and rear views of fan body in the third preferred embodiment of the present invention.]

DETAILED DESCRIPTION OF THE [PREFERRED EMBODIMENT] INVENTION

Fig. 2 [is the] shows an exploded view of the present invention. [The ceramic] Hollow ceramic tube bearing 2 passes through and [fixes on] is concentrically and fixedly attached to fan rotor 100, thereby rotating with the rotor. [The ceramic] Hollow [tube] ceramic tubular support bearing 4 [passes thru and fixes] is fixedly mounted onto fan base 107. [The] Axle tube 6 is cylindrical in shape or with an end flange portion forming a T-shaped (in cross-section) tube, which passes through the inside of bearing 2 and support bearing 4, and rotates slowly and asynchronously [and slowly] with rotor 100. [The] Ceramic holding ring 8 has an opening or gap and is installed at [one] the end of axle tube 6, opposite rotor 100 to limit axial movement of axle tube 6.

When the fan is energized and [in rotation] rotating, [the] bearing 2 [is rotating] rotates with [the] rotor 100, and [the] axle tube 6 [will be] is carried forward asynchronously, [and] thereby rotating slowly within [the] bearing 2 and support bearing 4. Since [the] bearing 2 and axle tube 6 are rotating at different speeds in the same direction, [it] this will greatly reduce

friction and increase fan speed and efficiency. To avoid [axial direction] movement of axle tube 6 in the axial direction, a ceramic holding ring 8 (a C-ring) is installed at the end of the axle tube. The combination of rotating bearing 2, fixed bearing 4, free-moving axle tube 6 (allowing slow rotation) and auto balancing of magnetic force [will] creates a stable high-speed [multipoint contact] rotating mechanism with minimum vibration and friction.

Figs. 3A, 3B and 3C show the cross-sectional, bottom and top views, respectively, of ceramic axle tube 6 [respectively]. The exterior of axle tube 6 is [formed or] ground or otherwise formed with concave grooves or with a non-circular shape to reduce surface contact [thereof friction] between bearing 2, support bearing 4 and axle tube 6, thereby reducing friction.

Figs. 4A and 4B show cross-sectional and top views of bearing 2 and support bearing 4, respectively. The exterior of bearing 2 is ground or otherwise formed with a concave outside surface [with smaller outer diameter or non-circular shape or concave] grooved [shape] to provide a solid connection with fan rotor 100. The interiors or bearing 2 and support bearing 4 are [formed or] ground or otherwise formed with concave grooves to reduce surface contact [thereof friction] among bearing 2, support bearing 4 and axle tube 6, thereby reducing friction.

Fig. 4C shows a cross-sectional view of [embedded] ceramic bearing 2 embedded into injection-molded [of] fan rotor 100. The exterior of bearing 2 and support bearing [6] 4 are formed [or ground to] with a concave surface [with smaller outer diameter or non-circular shape] or [concave] grooved shape to provide a solid connection with fan rotor 100. The concave or grooved shape facilitates the attachment of ceramic bearings 2 and 4 to plastic fan rotor 100 on the base 107. The present invention is [very] useful in producing small and thin [rotor] fans.

Fig. 5 shows a cross-sectional view of the [first preferred embodiment of the] present invention. [comprising a ceramic hollow tube shape bearing 2, support bearing 4 and axle tube 6 and a ceramic holding ring 8. The] Bearing 2 passes through and [fixes on] is concentrically and fixedly attached to fan rotor 100 and rotates with [the] rotor 100. [while] [the] Support bearing 4 [fixes on] is fixedly attached to fan base 107, [and works as] providing structural support [which do] and does not rotate. [The] Axle tube 6 is cylindrical in shape or [with] includes an end flange [portion] member, forming a T-shaped tube (as viewed in cross section). [and the] Axle tube 6 passes through the inside of bearing 2 and support bearing 4, and rotates asynchronously and freely with fan rotor 100. [The] Axle tube 6 functions as structural support to provide [multi-point contact] a rotating support mechanism with multi-point contact. [The] Ceramic holding ring 8 has an opening or gap and is installed at one end of axle tube 6 to limit axial movement of axle tube 6. Friction is further reduced by balancing of mannetic forces between stator coil 105 and permanent magnet 106.

THE FOLLOWING MATERIAL IN THIS SECTION, WHICH DESCRIBED SECOND AND THIRD EMBODIMENTS OF THE INVENTION IN THE ORIGINAL SPECIFICATION, IS NOW TO BE OMITTED ENTIRELY.

There is no special restriction to the manufacturing process [of] used to make hollow ceramic tube bearing 2 [,202,204], support bearing 4, [hollow] ceramic axle tube 6, [206 and] or ceramic holding ring 8 [,208] in the present invention. The preferred embodiments of the present invention [are using] use metal oxide ceramic powders (e.g. aluminum oxide, zirconium oxide, silicon oxide, etc.) or a mixture of two or more oxide powders [are used and], formulated with binding material known in the art. After molding, fragile ceramic "green bodies" are debinded [in] at low temperature (about 200-300 degrees Celsius, producing "brown bodies"), then sintered [in] at high temperature (over 3000 degrees Celsius) to produce objects of high mechanical strength and durable ceramic blanks. Ceramic blanks require further precision [processes] processing to [become] shape them into the components used in the present invention [ceramic bearing 2,202,204, support bearing 4 and axle tube 6,206]. [Precision grinding] These blanks are then ground and [polishing then apply to ceramic blanks] polished to achieve nearly true circular shape, to maintain low vibration and low-noise rotation. Ceramic holding rings 8 [,208] are made from ceramic blanks by slicing [ceramic blanks] them into circular rings, then cutting an opening [slot] on each ring.

[Therefore,] Compared with the prior art, the advances of the present invention may be [concluded] summarized as follows:

The present invention provides [an] improved [structure of rotation support] structural support for the rotation mechanism of a heat-dissipation fan by utilizing durable and high mechanical strength [and durable] ceramic for bearings, support bearings and axle tubes, to replace high-priced ball bearings or low-quality metal sleeves. In addition, various bearing and axle tube supporting structures are provided, and interior and exterior surfaces of bearings and axle tubes are further processed to [lower] reduce rotational friction [thereof resulting]. This results in a new heat-dissipation fan with lower noise, lower power consumption, longer life and higher rotational speed.

The present invention provides a [very] useful mass production method for manufacturing small and thin rotor fans. The exterior surfaces of bearings and support bearings are [formed or] ground or otherwise formed with [to] concave surfaces [with smaller outer diameter or non-circular shape] or [concave] grooved shapes to provide a simple but solid connection with the fan rotor body. [and] This is suitable for mass production of [embedded] injection-molded [of] fan rotor [body] bodies with the bearings embedded therein.

[The third preferred embodiment of present invention provides a very useful solution for high contamination and hostile environment. The rotor upper and lower bodies form a closed area to contain the rotation support structure of heat-dissipation fan and fan coil/electronic control circuit board, preventing dust and particles accumulation.]

The central novelty in the present invention is that the pin which fits between the two bearings is not fixed to either of them. Instead, it is free to rotate at a rotational speed different from that of the fan rotor itself. In practice, this pin (axle tube) rotates slowly, in the same direction as the fan rotor. This reduces friction greatly, compared to conventional fans. The other benefits of the fan described in the present invention have been discussed.

The present invention has been described using the foregoing [preferred] embodiment[s]. However, it is to be understood that the scope of the present invention is not limited to the disclosed embodiment[s]. On the contrary, it is intended to cover various modifications and similar arrangements. The scope of the claims, therefore, should be accorded the broadest interpretation so as to encompass all such modifications and similar arrangements.